COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS

GUIDEBOOK TO THE GEOLOGY

OF THE

PENNSYLVANIA TURNPIKE

By

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GUIDEBOOK TO THE GEOLOGY OF THE PENNSYLVANIA TURNPIKE

By A. B. Cleaves and Geo. H. Ashley

INTRODUCTION

Warning: Do Not Drive and Geologize at the Same Time

The Pennsylvania Turnpike presents an unexcelled opportunity for an intimate view of the surface and scenery of Pennsylvania and of the rocks that underlie and are responsible for that surface. Doubtless, many of the rock surfaces now exposed will soon be covered with vines and other vegetation. Yet it may be possible from exposures at tunnel mouths and in cuts here and there to get a broad picture of the rocks that underlie the Turnpike, and, with the aid of this guide, of the story they tell.

The Turnpike runs most of the way through the mountainous part of the State; here over a high plateau with broad flats and distant higher hills; there in low, broad valleys between high, narrow mountain ridges; here in a defile, there in open country; here in farm land and there in forest. The unique feature of this highway is that it pierces seven of these mountains with tunnels. The rocks are not visible in the completed tunnels, but during their excavation they gave one of the finest pictures of the makeup of the earth's surface to be found in the eastern United States.

The itinerary for this guidebook was partly prepared by Dr. Arthur B. Cleaves, who, with Mr. Joseph M. Gorman, had been loaned to the Turnpike Commission by the Pennsylvania Geological Survey. Before its completion Messrs. Cleaves and Gorman were drawn into the defense program in connection with the construction of new Atlantic air bases. The material, therefore, was assembled by Mr. Richard M. Foose, who also prepared notes on the rocks along the eastern end of the Turnpike. The text was written by the State Geologist.

The rock and surface features seen along the Turnpike are the result of a long train of events, involving the laying down of muds, sands, and limy marls in the sea, or by rivers or sheet waters on the land; their compacting and hardening into rocks, which subsequently were shoved to the west by titantic earth forces, folding them to form vast mountain ranges—not the present mountains; the wearing down of these mountains nearly to a plane, and the establishment of a complex river system. Finally this plane was uplifted and the softer rocks were etched out to form the present valleys, leaving the harder rocks in relief as the present mountains. This is a thumbnail sketch of the story. This guidebook first presents this story in a little more detail and then, starting from either end, points out where these features can be seen or where what you see belongs in the story.

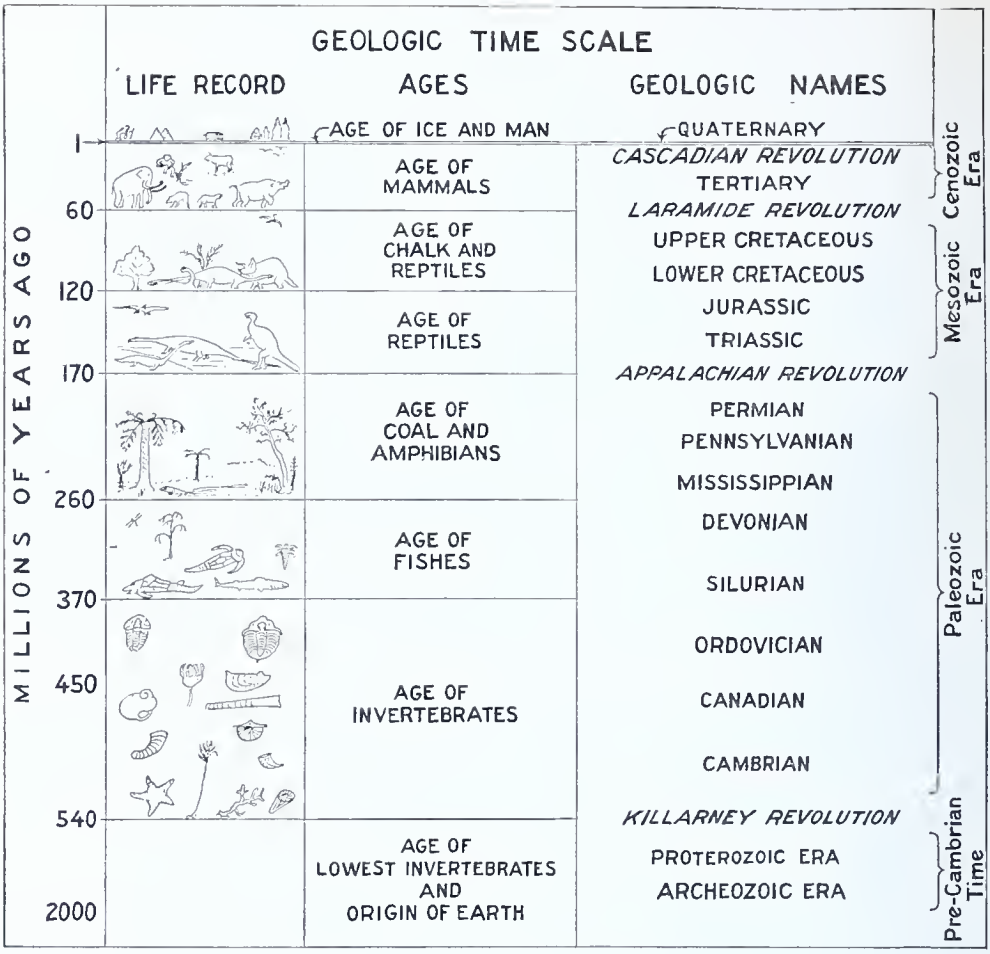


Figure 1. Geologic time chart

THE ROCKS

The rocks to be seen along the Turnpike are all bedded rocks; that is, they were originally deposited as beds of rock material in the sea, or on the land by rivers or sheet water; shales, at first mud; sandstones, quartzites, or conglomerates, at first sand or gravel; limestones, at first limy deposits. They were laid down between 450 and 225 million years ago in a shallow sea that at first covered only eastern and central Pennsylvania, but later spread over all of the State and far beyond. The position of the rocks in the geologic time scale is shown in Figure 1. The oldest rocks were laid down about in the middle of the Age of Invertebrates, and the youngest a little later than the middle of the Age of Coal. Still older rocks underlie the Turnpike, but crop out only in southeastern Pennsylvania; and younger rocks, of late Triassic age, crop out in a narrow belt across southeastern Pennsylvania.

The laying down of these rocks was the first chapter in the story of the making of Pennsylvania. Pennsylvania at that time was a shallow sea into which sediments were being washed mainly from the southeast. The bottom of this sea sank slowly and irregularly. At

times the sea filled faster than the bottom sank and much of the material was spread over the surface above sea level, and the shoreline moved far to the west. Several times, uplift replaced sinking and some of the sediments previously deposited were washed away. At times the areas from which sediments came were so low that neither sand nor mud reached the sea and only lime accumulated. At other times the source area must have been lifted high and great sheets of sand, to become sandstones, were spread widely over the State. These sheets of sand, from a few hundred to a few thousand feet thick, lying between great thicknesses of limestone or shale, were later to become hard layers that are responsible for the mountains and high plateaus of today. One of these came just at the end of the Age of Invertebrates and the beginning of the Age of Fishes (Medina sandstone,—Blue, Kittatinny, and Tuscarora tunnels); another at the end of the Age of Fishes and the beginning of the Age of Coal (Pocono sandstone,—Laurel Hill, Allegheny Mountain, Rays Hill, and Sideling Hill tunnels).

The youngest rocks exposed along the highway are at its western end at Irwin; the oldest are exposed in the middle between Bedford and Everett. At the Allegheny Mountain tunnel it would require a 20,000-foot shaft or drill hole from the top of the mountain to reach the limestones seen east of Bedford. The following table gives the succession of beds from the top down, with the thickness and a brief characterization of the rocks. Exact figures commonly mean exact measurements in the tunnels or cuts, or in drill holes made in connection with building the Turnpike:

TABLE OF ROCK STRATA

	Thickness in feet
Carboniferous age	
Pennsylvanian system	
Pittsburgh series	
Monongahela group. Upper coal group with Pittsburgh coal bed at base	250 to 400
Conemaugh group. Shales, sandstones, some limestones, and a little coal, 600-900 feet	650
Allegheny group (Freeport, Kittanning, Clarion coals, clays, limestones, and sandstones)	300
Pottsville series. Mostly sandstone, crest of Allegheny Mountain. Up to 7,000 feet thick in Southern States, here	50 to 250
Mississippian system	
Mauch Chunk (Chester) series. Red and greenish-gray sandstones and shales (contains Greenbrier limestone, 5 to 25 feet), hill and valley topography	262 to 606
Loyalhanna, cross-bedded, sandy limestone or calcareous sandstone, 37 to 62 feet	50
Pocono, massive, hard, gray and blue, cross-bedded sandstones (basal part is uppermost Devonian); mountain maker (plate 3-A)	1,230
Siluro-Devonian age	
Devonian system	
Catskill facies. Red shales and sandstones with interbedded green shales and sandstones; tends to make high, hilly land, 2,500 feet at Allegheny Mountain; at east (plate 3-B)	4,500

Chemung facies. Alternating sandstones and shales (see plate 4-A). Source of most of oil and gas found in Pennsylvania	2,200
Portage facies. Brown and gray to black shales and sandstones, valley-maker. (Genesee black shale and Tully limestone at base)	2,100
Hamilton, massive and thin-bedded gray to tan sandstone interbedded with multicolored shales. Valley-maker. (Marcellus black shale at base)	1,575
Onondaga, black and gray shales at base, limestone at top	150
Oriskany, consisting of the Ridgeley, white to bluish gray, calcareous sandstone, and the Shriver, blocky, grayish-black, impure, cherty limestone	125
Helderberg limestone, consists here of the New Scotland cherty limestone, and above, the Coeymans, a very crystalline limestone	70
Silurian system	
Keyser, massive gray and blue-gray limestone	150
Tonoloway, bluish-gray, thin-bedded shaly limestone, in places entirely gray shale	700
Wills Creek, soft, thin, green and yellow shales which vary to dove gray and red shale at places; calcareous at top	209
Bloomsburg, unfossiliferous, soft, thin-bedded red shales, interbedded with sandstone	207
McKenzie, green to gray limestone, interbedded with greenish shale that weathers brown; full of fossils	259
Keefer, massive-bedded sandstone to cream-colored, fossiliferous quartzite	48
Rose Hill (Clinton), mostly thin-bedded red shale and thin, inter-bedded sandstones	575
Tuscarora, heavy-bedded, white and gray sandstone and quartzite (upper Medina), hard and resistant; therefore a mountain-maker	395
Cambro-Ordovician age	
Ordovician system	
Juniata, red sandstone and shale (middle Medina). Subordinate valley-maker	608
Bald Eagle (Oswego, lower Medina), greenish gray, massive and medium-bedded sandstone, subordinate mountain-maker on Turnpike	119
Martinsburg, dark tan to rust-colored shales which weather to thin, splintery, and hackly fragments. It is interbedded with thin, tan sandstones; in valleys	1,500
Chambersburg, platy beds of dense gray limestone interbedded with dark gray shale, 100-750 feet; in valleys	500
Canadian system	
Stones River, semi-massive, bluish limestone in valleys; fossils, 675-1,050 feet	1,000
Beekmantown, blue-gray to blue, heavy-bedded, often cherty dolomite in valleys; fossils rare	2,300
Older rocks are exposed further east, and further northeast of Allegheny Mountain, but not along the Turnpike. Exact figures in the above table represent accurate measurements made possible in the excavation of the tunnels or highway cuts.	

In the following text Medina is an inclusive term for the Tuscarora, Juniata, and Bald Eagle sandstones.

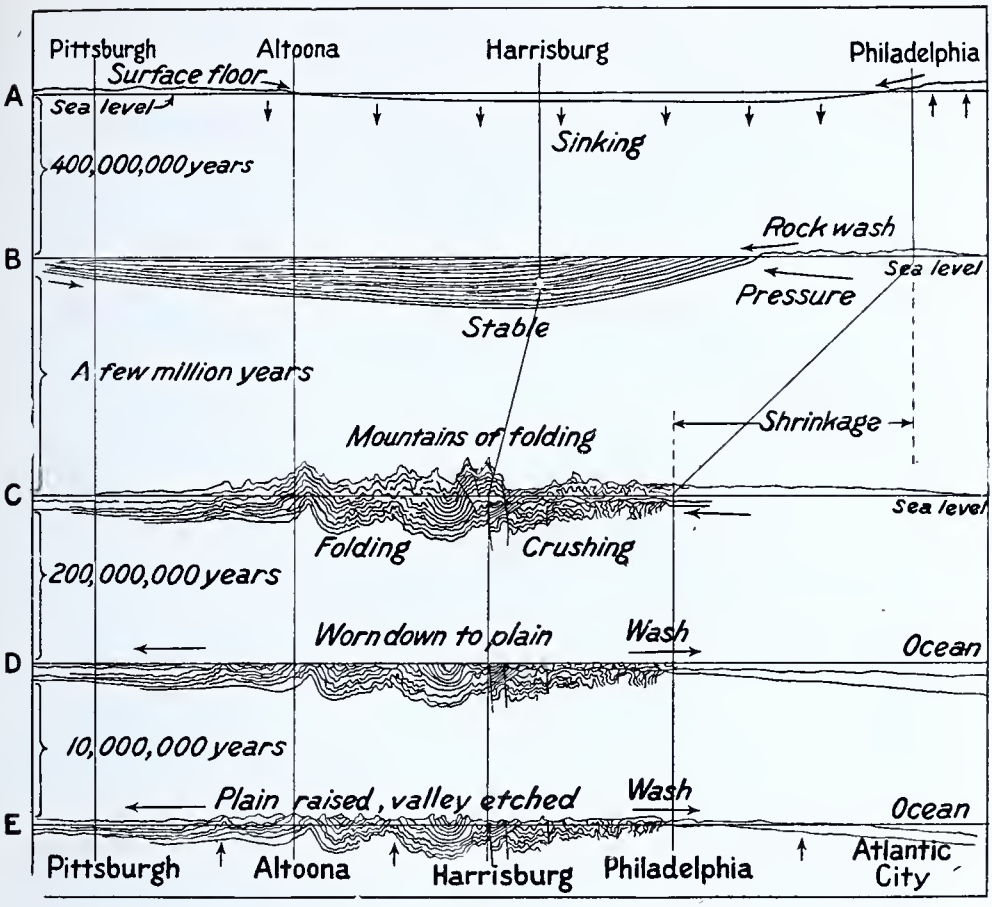


Figure 2. Chart showing principal events in the geologic development of the rocks along the Turnpike

HISTORY OF THE ROCKS

The first chapter in the story of the rocks has already been sketched and a table given of the rock strata that appear along the Turnpike. In the second chapter these thousands of feet of rocks were horizontally compressed as though from the southeast and folded, crushed, and broken, resulting in a great shrinkage of the area they covered. They were squeezed up into folds that made mountains—not the present mountains—as high as the Alps or Andes. It was at this time that the beds got the tilting that is observed east of Allegheny Mountain. From Allegheny Mountain to Blue Mountain the shortening has been estimated to have been about 15 percent, or 20 miles.

Without going into details, many of which are still to be unravelled, the third chapter is believed to have been a long, quiet period of standstill during which the mountainous folds formed by the pressures just referred to gradually wore down until the whole surface of Pennsylvania was reduced nearly to a plane, reflected today in the flat, even crest line of so many of the ridges of Pennsylvania and throughout the Appalachian region. Across this plane the rivers of the region flowed seaward with little or no regard to the position or strike of

the upturned edges of the folded rocks under the surface. It has long been thought that during this period, which covered all of the Age of Reptiles and Chalk and most of the Age of Mammals of the chart (see fig. 1), the rivers had acquired southeast courses running directly to the sea, courses still maintained by parts of most of the rivers running to the Atlantic between New England and Virginia or beyond. But the presence of many water gaps with north-flowing streams, and the discovery that many of the gaps coincide with points of transverse faulting, suggest that the drainage history of this period may have been much more complicated than this simple story would indicate.

The fourth chapter began when broad crustal uplift set in, apparently centering in a line that crossed Pennsylvania a little east of north from western Bedford County through Altoona and western-central Clearfield County. As uplift proceeded the drainage gradually became adjusted so that the main rivers flowed southeastward to the Atlantic, and northwestward to a major stream where Lake Erie now is. The southeastward drainage had the advantage of a shorter distance to the sea and so it tended to extend its headwaters and push the divide between the two drainage systems to the west. The present heads of the West Branch of the Susquehanna and Juniata Rivers occupy territory that formerly drained westward. At the same time the minor streams more and more were restricted to the belts of soft or soluble rocks which were etched out into valleys almost as fast as the crust of the earth rose, leaving the more resistant rocks standing in relief as mountains or plateaus. The main streams that acquired a southeast "set" before this uplift seem to have continued in their old courses as uplift proceeded and cut water gaps across hard strata that otherwise stood in relief.

The fifth chapter hardly affected the area of the Turnpike. In it, glacial ice pushed southward, blocked the northwest drainage, and turned it to the south and west to form the present Allegheny and Ohio Rivers.

PHYSIOGRAPHIC AND STRUCTURAL PROVINCES

As a result of these several events, Pennsylvania today may be divided into a series of zones or provinces, in general running northeast and southwest, in which the surface forms, the rocks, and the structure differ. These are shown in plates 1 and 2 and figure 3.

The Turnpike crosses the Pittsburgh section and Allegheny Mountains section of the Appalachian Plateau province and the Ridge and Valley section, and Great Valley section of the Appalachian Valley province.

Appalachian Plateaus province

Pittsburgh section. The rocks of the Pittsburgh section are all of Pennsylvanian age. They lie nearly flat, seldom exceeding a dip of more than 400 feet per mile and around Pittsburgh usually dipping less than 100 feet to the mile. The surface consists of V shaped valleys, the upper part broad, the lower part narrow, and A shaped hills with broad tops. The tops of the hills are seldom flat, but rise so nearly to the same elevation as to appear from a distance like a great plain. The presence of valuable beds of coal, clay, sandstone, lime-

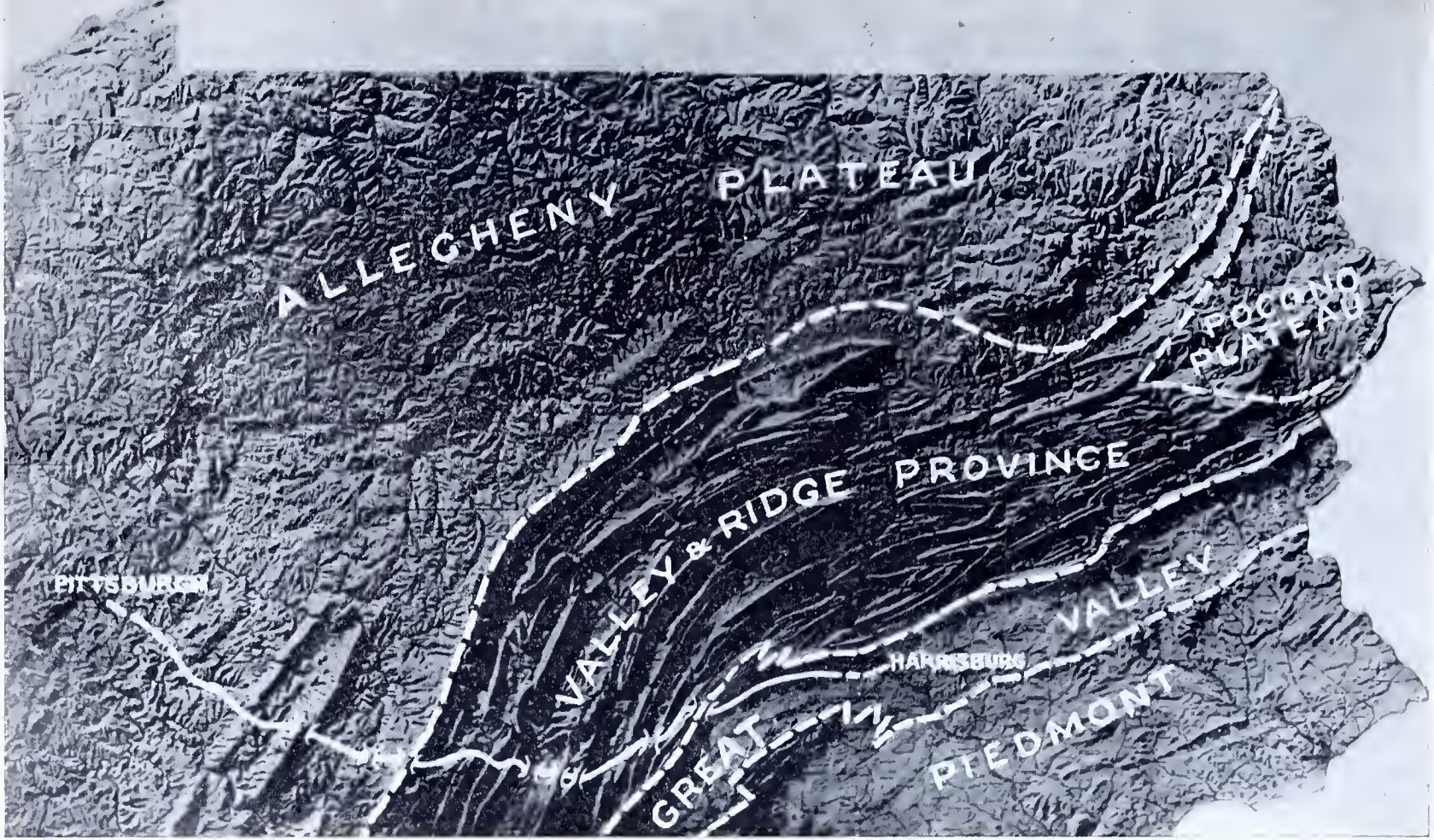
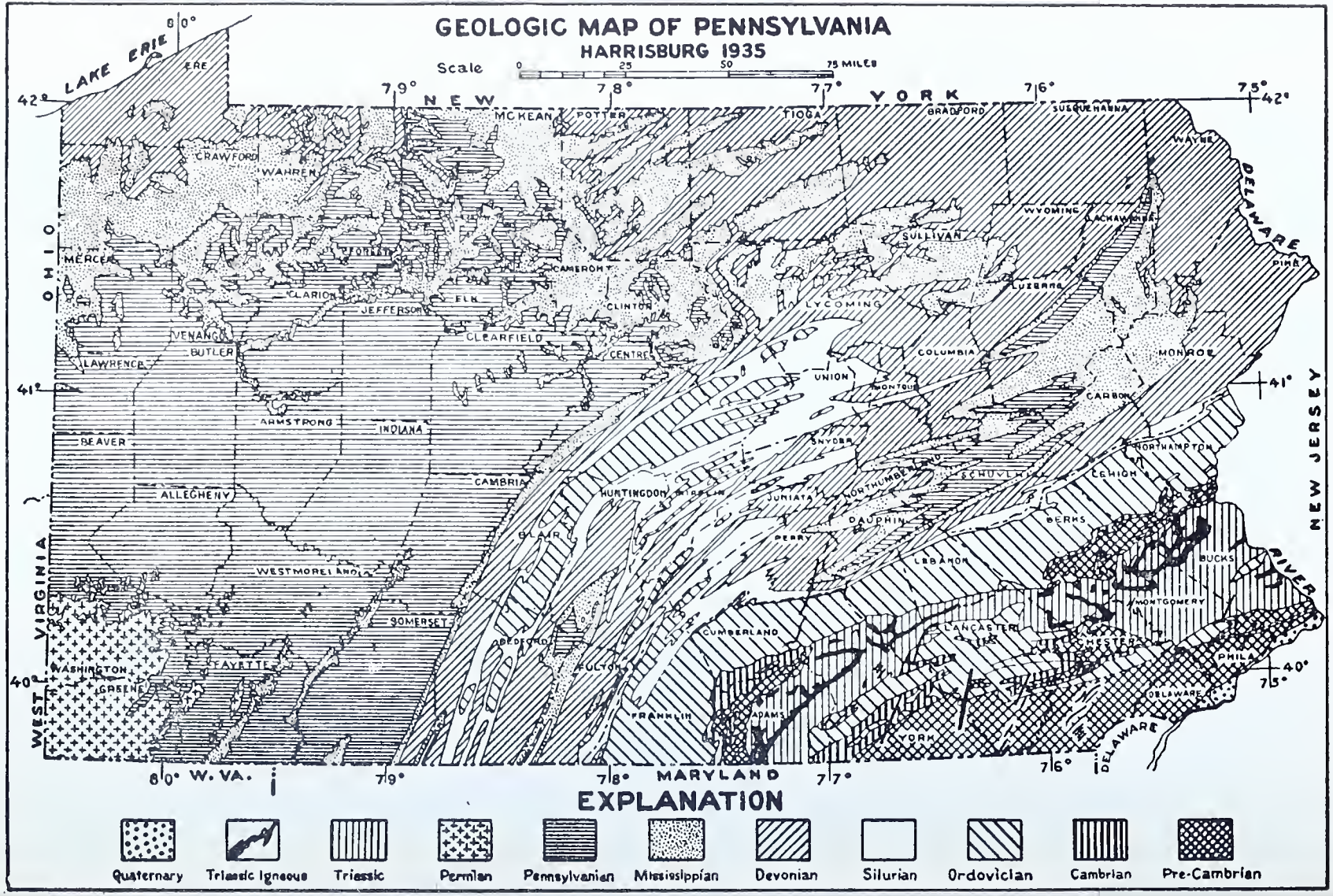


Plate 1. Relief map of Pennsylvania showing route of Turnpike and physiographic provinces of Pennsylvania


GEOLOGIC MAP OF PENNSYLVANIA
HARRISBURG 1935
Scale
0 25 50 75 MILES
LAKE ERIE
ERE
NEW YORK
MCKEAN
POTTER
TIOGA
BRADFORD
SUSQUEHANNA
WAYNE
DELAWARE
PIKE
CRAWFORD
WARREN
WYOMING
LACKAWANNA
SULLIVAN
OHIO
MERCER
FOREST
CAMERON
LUZERNE
CLARION
JEFFERSON
ELK
CLINTON
LYCOMING
VENANGO
CLEARFIELD
BUTLER
CENTRE
COLUMBIA
MONROE
LAWRENCE
UNION
MONTOUR
CARBON
ARMSTRONG
INDIANA
SNYDER
NORTHAMPTON
BEAVER
NORTHUMBERLAND
SCHUYLKILL
LEHIGH
CAMBRIA
ALLEGHENY
HUNTINGDON
JUNIATA
DAUPHIN
BERKS
BLAIR
PERRY
LEBANON
BUCKS
WESTMORELAND
MONTGOMERY
SOMERSET
CUMBERLAND
LANCASTER
CHESTER
PHILA
WASHINGTON
FAYETTE
BEDFORD
FULTON
GREENE
DELAWARE
FRANKLIN
ADAMS
YORK
RIVER
NEW JERSEY
WEST VIRGINIA
W. VA.
MARYLAND
EXPLANATION
Quaternary
Triassic Igneous
Triassic
Permian
Pennsylvanian
Mississippian
Devonian
Silurian
Ordovician
Cambrian
Pre-Cambrian

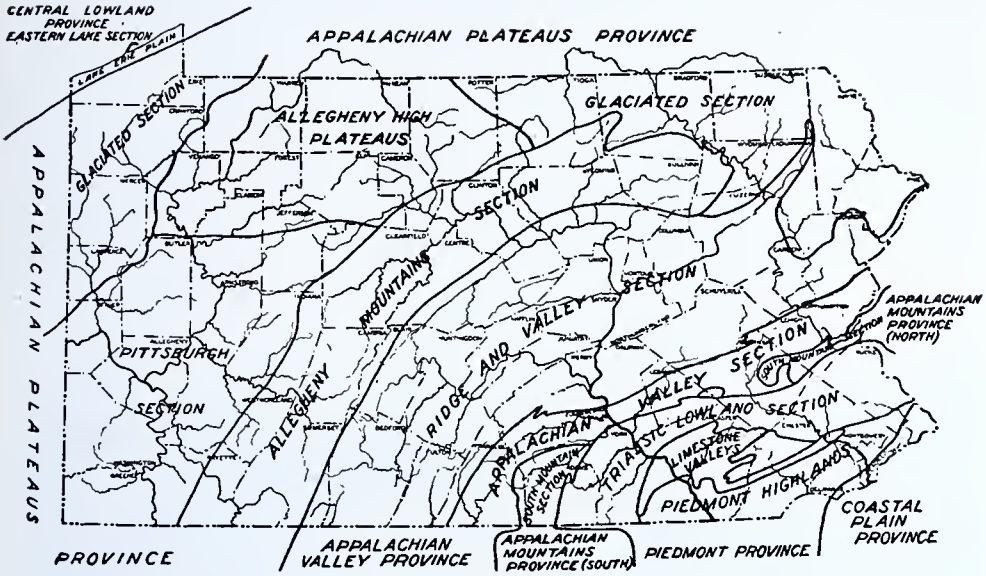


Figure 3. Physiographic divisions of Pennsylvania

stone, and some iron ore in this area, combined with navigation on the Ohio and its tributaries, makes this a highly industrial area.

Allegheny Mountains section. Between Chestnut Ridge and Allegheny Mountain the Turnpike crosses a series of mountains and high plateaus, and from Laurel Hill tunnel to Allegheny Mountain tunnel the average elevation of the Turnpike is nearly 2,300 feet above sea level. The Turnpike is so planned that, although it must cross the mountains in this section near their tops because of their great breadths, it follows high divides from one mountain to the next, keeping within 3° grades, and thus avoids the saw-toothed profile of routes 22 and 30 on which 8 percent grades are common, and which locally have grades up to 11 percent. The rocks of this section are still mainly the Coal Measures or Pennsylvanian, but the several sharp arches forming the mountains expose the underlying Mississippian and some of the steep, flanking ravines cut into the uppermost Devonian. Note also that the strata rise faster or are steeper than the topography. Thus the coal beds being worked in Somerset County, with elevations of 2,000 feet or more, are hundreds of feet below river level at Pittsburgh. The rocks in this section are warped more than further west. Dips of 300 to 400 feet to the mile are common and locally may reach 1,200 feet to the mile. This section was a buffer between the highly folded area to the east and the slightly disturbed area to the west.

Appalachian Valley province

Ridge and Valley section. From Allegheny Mountain tunnel to Blue Mountain tunnel the Turnpike traverses the Ridge and Valley section of the Appalachian Valley province, which here is about 100 miles wide. Imagine a pile of large rugs, some soft-textured, some firm and strong, pushed from one side until crumpled into many

folds, then the tops of the folds sheared off, and finally the upfolded edges of the soft-textured rugs worn down to form depressions parallel to the folding, leaving the edges of the firm-textured rugs projecting as ridges. Notice the intricate pattern of the folds as shown in the relief map, plate 1. (See also fig. 12). The ridges represent the hard strata, as with the rugs. While some of the folds are long (those in nature may be 100 miles long or more), some are short and run out in a few miles or are replaced by other folds either in front or behind them. In places the Turnpike takes advantage of water gaps through the ridges (see figure 4), or it runs around the end of some of the

Figure 4. Water gap in Tussey Mountain west of Everett

folds. But several of the ridges are so long that to save distance they must either be surmounted or tunnelled. Fortunately, unlike the broad plateau mountains, the ridges of the Ridge and Valley section are narrow, for the resistant sandstones that form them are usually thin and turned up at steep angles, in some places vertical. So, whereas Route 30 crosses Sideling Hill at 2,200 feet and Tuscarora Mountain at 2,100 feet above sea level, the Turnpike tunnels the first at only 1,300 feet above sea level, and the second at only 1,000 feet. Where the ridge crests can be seen from a distance, notice again the tendency for the ridges to be level-crested (see figure 5). This is not so obvious from the Turnpike as from the other routes which climb to the crests of the ridges and give wider views than can be obtained from the Turnpike.

Figure 5. Level crest of Tussey Mountain

The rocks traversed in the Ridge and Valley section are all older than those crossed west of Allegheny Mountain tunnel, continuing down almost to the Cambrian. Indeed Cambrian rocks are exposed a little north of the Turnpike. The valleys are broad because the limestones, shales, and less resistant sandstones are thick and constitute most of the section. Here again, by following minor divides and clinging to hillsides, the Turnpike avoids much hill climbing. Thus between Sideling Hill and Tuscarora Mountain, Route 30 climbs 1,400 feet (from 800 feet to 2,200 feet) from Harrisonville to the summit of Sideling Hill, and 1,350 feet to the top of Tuscarora Mountain, while the Turnpike climbs only 400 feet (from 900 feet to 1,300 feet) from Fort Littleton to Sideling Hill tunnel and 100 feet (900 to 1,000 feet) to Tuscarora tunnel with 1 to 3 percent grades as compared with 8 percent grades on Route 30.

The rocks crossed in the Ridge and Valley section are, in general, highly folded, but locally, as between New Baltimore and Manns Choice, and between Everett and Fort Littleton, they are much less folded, and in places lie flat. But from Burnt Cabins to Blue Mountain tunnel the rocks are tightly folded and several of the folds have broken and the upper part has pushed over the lower part in what is called a thrust fault.

Great Valley section. Emerging from Blue Mountain tunnel or starting from Harrisburg or Carlisle, one sees a broad valley 10 to 20 miles wide set between mountains on both sides that rise 1,000 to 1,500 feet above the general valley level. This valley is really a "vale" as it is not a river valley in the usual sense. Many rivers flow across it, as does the Suequehanna, and several rivers follow it for a distance. But in general it is the result of weathering and is part of a trench running from the St. Lawrence Valley down the Hudson Valley in New York, and across Pennsylvania, and south to Alabama. The south side of the valley is underlain by Cambro-Ordovician limestones and the north by Upper Ordovician shale (Martinsburg). Structurally these rocks are generally much crumpled and faulted, and in many places thrust faulting has broken them and pushed one part far over another part.

THE TRIP

With this introduction we are ready to begin the trip. For convenience in reading from either end, the trip has been divided into "blocks" as on a railroad. Distances from the eastern end are shown on the left side of the itinerary and from the western end on the right side.

Persons travelling on the Turnpike should acquaint themselves with speed limits, facilities provided at interchanges and gasoline stations, and distances between points by obtaining a folder at the Turnpike Commission offices in Harrisburg or at any of the ticket booths.

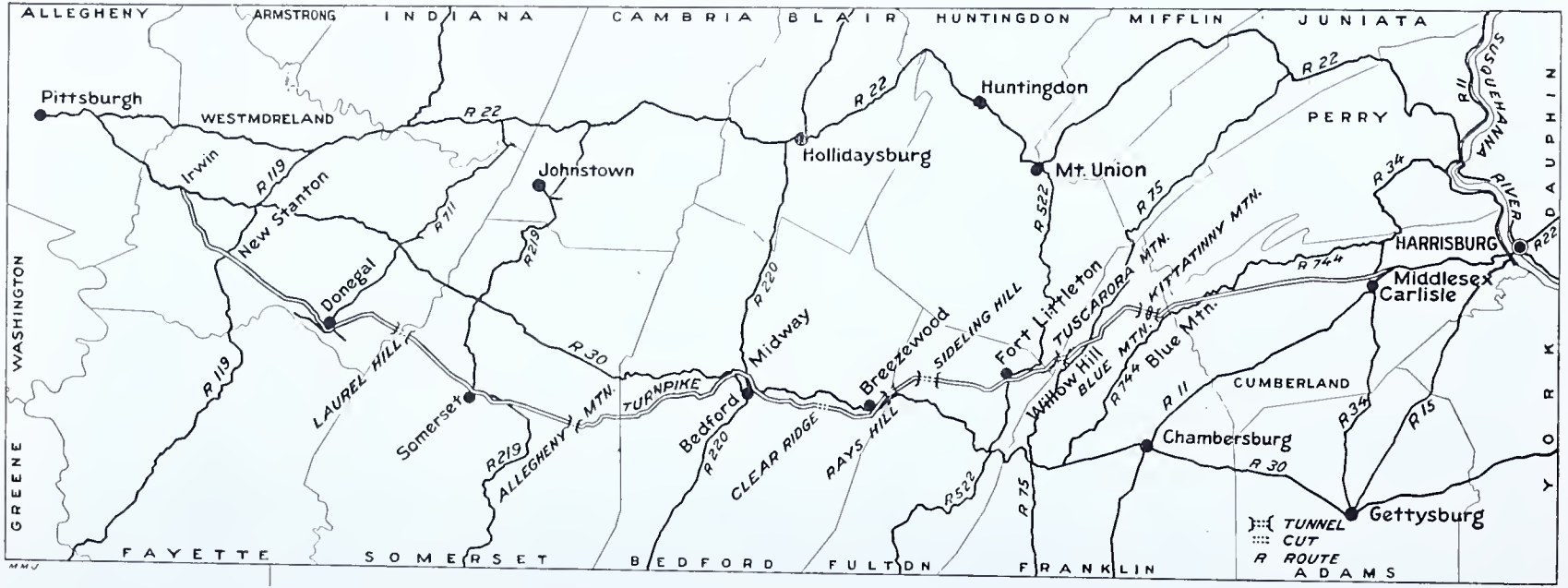


Figure 6. Map of the Turnpike, showing Routes 22 and 30, and interchanges

A. Massive Pocono sandstone

Because of its resistance to erosion, the Pocono sandstone makes some of the mountains in the central part of the State. Along the Turnpike it makes Sideling Hill, Rays Hill, and the knobs in front of Allegheny Mountain.

B. Catskill red shale and sandstone

The Catskill red and green beds are 2,500 to 4,500 feet thick, and are largely of continental origin. They are well exposed east of Sideling Hill, from Rays Hill to Clear Ridge cut, and west of New Baltimore.

A. Catskill and Chemung shale and sandstone

Catskill beds at left of figure, Chemung at right. This picture was taken on the Pennsylvania Railroad west of Altoona but is typical of the formations along the Turnpike.

B. Beekmantown limestone

A. Slight fold in Catskill rocks

B. Vertical fault plane in Martinsburg formation at west portal of Kittatinny Mountain tunnel

A. Kittatinny Mountain tunnel as found

This part of the tunnel was in fine condition and the cut stone facing at the entrance was in place. Some tunnels were so badly caved as to be dangerous to enter. The western part of Kittatinny tunnel sloped in and at the face was nearly full of water. Exploration by the geologists was done from a raft.

B. Completed entrance to Kittatinny Mountain tunnel

This poured concrete construction is typical of all the tunnel entrances.

Block 1. Middlesex to Blue Mountain tunnel. (27.1 miles)

This stretch of the Turnpike is all in the Great Valley. Leaving Harrisburg, Kittatinny (Blue or North) Mountain is on the north, rising to 1,300 feet, and 5 to 10 miles to the south rise cone-shaped hills, formed by resistant trap rock (diabase) of Triassic age. The valley between is mostly low, near Harrisburg only 400 feet above sea level. The old highway, Route 11, passes through Lemoyne and Camp Hill, suburbs of Harrisburg, through Hogestown and New Kingston. On the north is Conodoguinet Creek, on the south Yellow Breeches Creek. The flat valley bottom has sometimes been correlated with similar levels as a part of the Summerville peneplane, or it may be purely local. Note the long meanders of Conodoguinet Creek on the north, now incised 140 feet. North of the highway between Hogestown and New Kingston is a flat-topped hill at 540 feet elevation. Hundreds of similar flat-topped hills in this region led to the idea of an old erosion level, which has been called the Harrisburg peneplane. A mile west of New Kingston a road turns south along a low ridge made by a Triassic dike of trap rock, readily seen in the highway and railroad cut. The dike offsets ⅛ mile at the highway. The dike was formed by molten rock forced up from deep within the earth. This brings us to the eastern end of the Turnpike at Middlesex, 183 miles from Pittsburgh (fig. 7).

Figure 7. Eastern end of Turnpike

For 11½ miles the Turnpike continues on the south side of Conodoguinet Creek. The valley floor rises slowly to the west, reaching 500 feet near Plainfield. Meanwhile the wide hilltops ("Harrisburg peneplane") have risen to 600 feet and are close to 700 feet before Blue Mountain tunnel is reached. (Notice the seemingly flat valley surface in figure 8, Harrisburg peneplane, with Kittatinny (Blue) Mountain in the background). The mountain to the north rises from 1,300 feet at the Susquehanna to 1,600 feet northwest of Carlisle. It then becomes involved in a series of sharp folds that make it weave

back and forth like a drunken sailor, at the turns rising nearly to 2,000 feet. Figure 9 shows at the right the point of one of these turns and on the left the long swing back on the west side of Doubling Gap Creek. About due south of New Kingston is the eastern end of South Mountain (Blue Ridge further south), which, rising to 2,000 feet or more, makes the other side of the Great Valley. South Mountain is underlain and flanked by the very old rocks that underlie those seen on the Turnpike.

Figure 8. Harrisburg peneplane and Kittatinny Mountain

Seen from Turnpike at Carlisle Interchange. Cottages are on bank of Conodoquinet Creek.

Figure 9. Doubling Gap seen from the Turnpike

Here Kittatinny Mountain doubles back on itself, making two hairpin loops, each five miles long. This ridge is called Blue Mountain on old topographic maps and at the first tunnel.

Mile-posts on the north side or right of the road, in the line of reflector markers, show the distance from Middlesex Interchange. Odometers vary, so check distance by mile-posts. The abbreviations e-b and w-b indicate whether gas stations serve eastbound or westbound traffic.

From Middlesex Miles		*From Irwin* Miles
	(Entering Turnpike, set odometer at 0 mile)	
0.0	Between crossing of Conodoguinet Creek and east end of Turnpike all cuts are in Chambersburg limestone (middle Ordovician). Notice shaly character of much of limestone, red color of soil from contained iron, rounded weathering of limestone outcrops or boulders, pitted weathering in places, and calcite veins locally.	159.6
1.0	Turnpike here on top of 520-foot hills, thought to be trace of Harrisburg peneplane.	158.6
2.1	Ticket booth, Carlisle Interchange, Route 34. Carlisle, county seat of Cumberland County, is famous in Colonial and Civil War history, is the site of Dickinson College (founded in 1783), and was the site of "Public Works", a cavalry post for a century (1777), then of Carlisle Indian School, which has been enlarged and converted into U. S. Army Medical Department Field Service School. Carlisle is identified by several elevated water tanks.	157.5
4.85	Old lime kiln and outcropping limestone.	154.75
7.5	Plainfield gas station (e-b). J. S. Diller, geologist of U. S. Survey 1883-1928, is buried in cemetery on south side.	152.1
10.3	Remains of lime kiln in field on south.	149.3
11.6	Cross Conodoguinet Creek. Martinsburg shale (about 1,500 feet thick) between creek and Blue Mountain tunnel.	148.0
14.4	50-foot cut in splintery black shale with rounded surfaces. Small warps.	145.2
16.5	Note crumpling and faulting in shale; view of Doubling	143.1
17.5	Gap on north.	142.1
21.0	View northeast up Doubling Gap Valley. Note winding crest of mountain.	138.6
24.1	Blue Mountain gas station (w-b).	135.5
25.3	Blue Mountain Interchange, connects with State Route 944. Views of Great Valley and South Mountain beyond. A short walk up dirt road to north shows the Martinsburg shale and gives a good view over the valley.	134.3
27.1	East portal, Blue Mountain tunnel. Eastbound, Turnpike is in Martinsburg shale for 15 miles to crossing of Conodoguinet Creek.	132.5

Block 2. Blue Mountain and Kittatinny Mountain Tunnels. (1.9 miles)

As the outstanding feature of this highway is that it tunnels the mountains instead of climbing over them, this may be a good place to pause and review the history and construction of the tunnels. Without going into details, in the early 1880s Andrew Carnegie, backed by Vanderbilt of the New York Central, undertook to build a railroad to compete with the Pennsylvania. Plans were made and the South Penn Railroad was begun, to include nine tunnels. The tun-

nels were started, grading was begun, bridge piers were built at Harrisburg and elsewhere. Then in 1885 terms were reached with the Pennsylvania Railroad and the South Penn project was dropped, with its tunnels half completed. Fifty years later the project was revived, this time as a highway for motor cars. Two geologists, Arthur B. Cleaves and Joseph M. Gorman, were borrowed from the Pennsylvania Geological Survey supposedly for a few days, or weeks at the most; but it was soon found that the geologic end of the work was to be a full-time job.

Figure 10. East portal of Blue Mountain tunnel as found

It may be of interest to note pictorially conditions as the geologists and engineers found them. Figure 10 shows the east portal of the Blue Mountain tunnel when first examined. Plate 6-A shows the conditions in Kittatinny tunnel when first entered. Compare with the tunnel today, plate 6-B, or with an inside view of the completed tunnel, figure 23. Suffice to say here that, although some of the tunnels were in hard rock and had deteriorated but little, others had not only

fallen shut, but the roof rocks had weathered and softened until they presented very difficult engineering conditions. It was put up to the geologists to determine the nature of the rock not yet tunnelled through, and their bearing on the future construction of the tunnel, to determine the nature and probable effect of waters entering tunnels, the presence and value of minerals, coal, clay, building stone and other rocks under the Turnpike right of way, and to recommend treatment of old coal-mine workings under the pike near its western end.

It may be of interest that a horizontal diamond-drill hole in the face of Kittatinny tunnel directly under the crest of the mountain penetrated a mass of silica sand so saturated with water and under such pressure that hundreds of tons of sand blew out of the drill hole. This spot is now protected by a 5-foot layer of concrete.

The following figures regarding the tunnels, giving lengths in feet, may be of interest (see figure 11). The first column gives the length from portal to portal, the second excludes the service structure at the portals, and the other columns show the work done and unfinished by the South Penn Railroad.

Table of Tunnels

Tunnel	Total length	Rock cut	West heading	East heading	Undriven section
Blue	4,339	4,178	1,141	1,863	1,174
Kittatinny	4,727	4,572	1,646	2,375	551
Tuscarora	5,326	5,167	1,785	1,930	1,452
Sideling	6,782	6,623	1,572	1,672	3,379
Rays	3,532	3,396	1,088	1,307	1,001
Allegheny [1]	6,070	5,907			5,907
Negro [2]		1,091	48	688	355
Quemahoning [2]		735			
Laurel [3]	4,541	4,368	813		3,555

[1] For engineering reasons old tunnel not used. Complete new tunnel driven, offset 85 feet south.

[2] Not used; deep cut made south of old tunnel. Quemahoning was completed.

[3] Line shift and grade change shortened tunnel from 5,365 feet. Old east heading caved; new entrance west of former.

The tunnel sections (fig. 11) show the rocks are almost vertical in the three easternmost. In each of these, the Bald Eagle, Juniata, and Tuscarora (former Medina) are the rocks whose resistance to weathering has produced the mountains, though at the level of the tunnel a considerable thickness of the adjoining softer rocks older and younger were also involved. Blue Mountain and Kittatinny Mountain are parts of the two sides of a trough or syncline, so narrow that only a narrow valley intervenes. The Medina sandstones plunging downward in Blue Mountain turn at so great a depth before rising vertically again in Kittatinny Mountain that the Bloomsburg shales occupy the valley. West from Kittatinny Mountain the Medina sandstones keep above the surface in the line of the Turnpike, though not on either side, until they plunge below the surface again in Tuscarora Mountain (see figures 12 and 13). They rise again for a high, narrow arch between Everett and Bedford and then go under only to reappear along the

shore of Lake Ontario. Near Everett and Bedford the Turnpike crosses them by way of water gaps. Plate 7 shows two stages in the construction of the new tunnels.

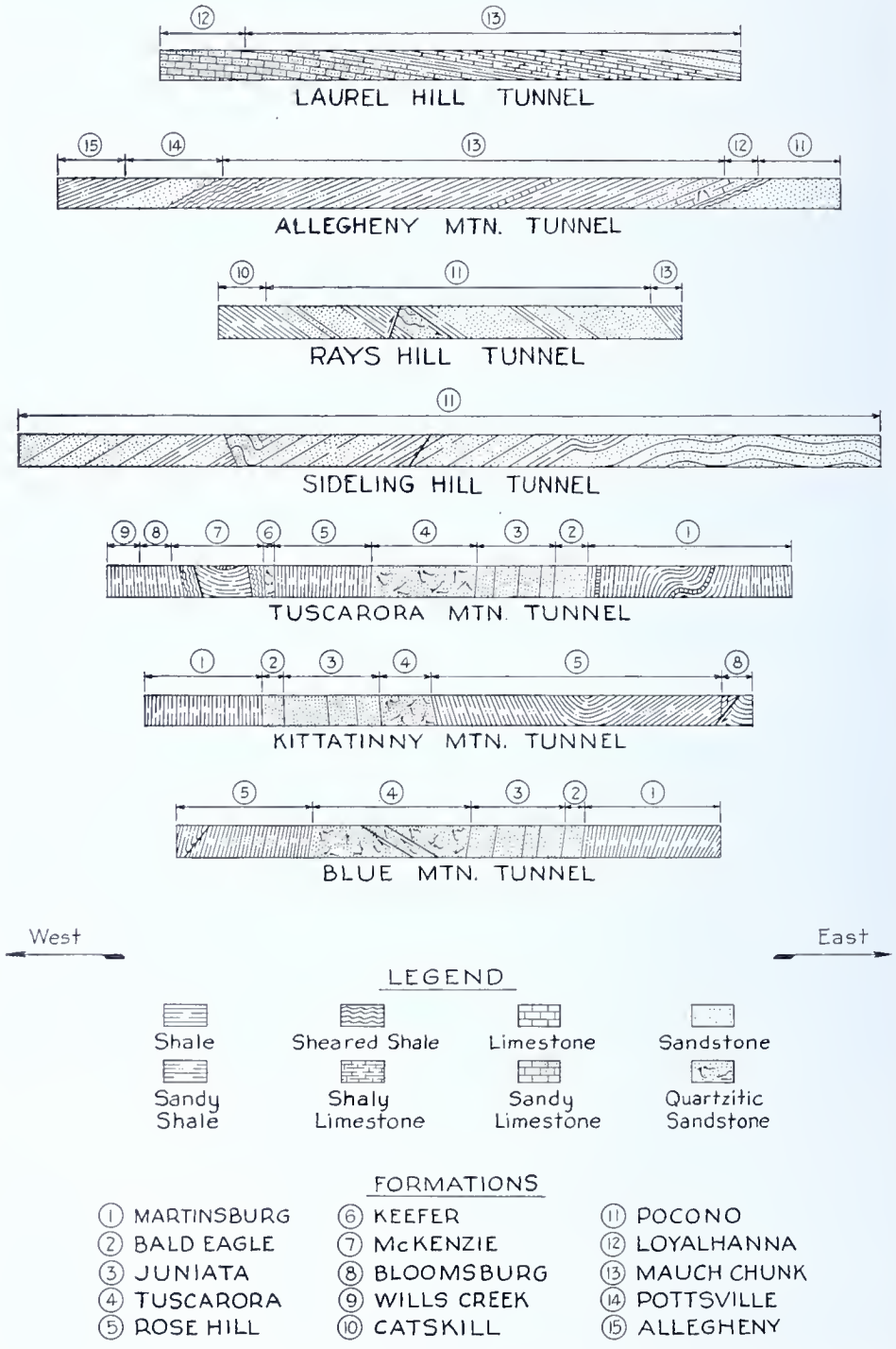


Figure 11. Cross sections showing the geology of the Turnpike tunnels

A. Turnpike tunnel during construction

B. Forms for concrete lining of tunnel

A. Sidneys Knob and cut in limestone near Burnt Cabins

The Turnpike dodges around some mountains instead of tunneling through them. The scenery ranges from open, rolling topography and farms to steep mountains and forests.

B. Gobblers Knob west of Burnt Cabins

Tests have proved that it is safe to travel all curves on the Turnpike at a higher speed than 70 miles per hour. This super-highway has four 12-foot lanes. A parkway 10 feet wide separates east- and westbound traffic.

A. Clear Ridge cut before completion

This cut halfway between The Midway and Rays Hill is 153 feet deep and 2,475 feet long. It is the deepest highway cut in the eastern part of the United States. Color banding of the rocks is notable. The material removed was used for a 98-foot fill on the west.

B. Clear Ridge cut completed

A 23-foot bench 30 feet above the highway and a 15-foot bench 80 feet up were cut in the slopes to handle drainage and stop rock falls.

A. Mt. Dallas cut seen from across Raystown Branch

Here a slice 800 feet long was cut off the nose of Tussey Mountain. The long narrow mountain is explained by the greater resistance of the highly siliceous sandstone and quartzite to erosion in comparison with the limestone on the west and the thin shaly beds on the east. The rocks dip toward the east at a high angle. Juniata River has cut its gap down through the mountain from a former position near its top.

B. Tuscarora sandstone in Mt. Dallas cut west of Everett

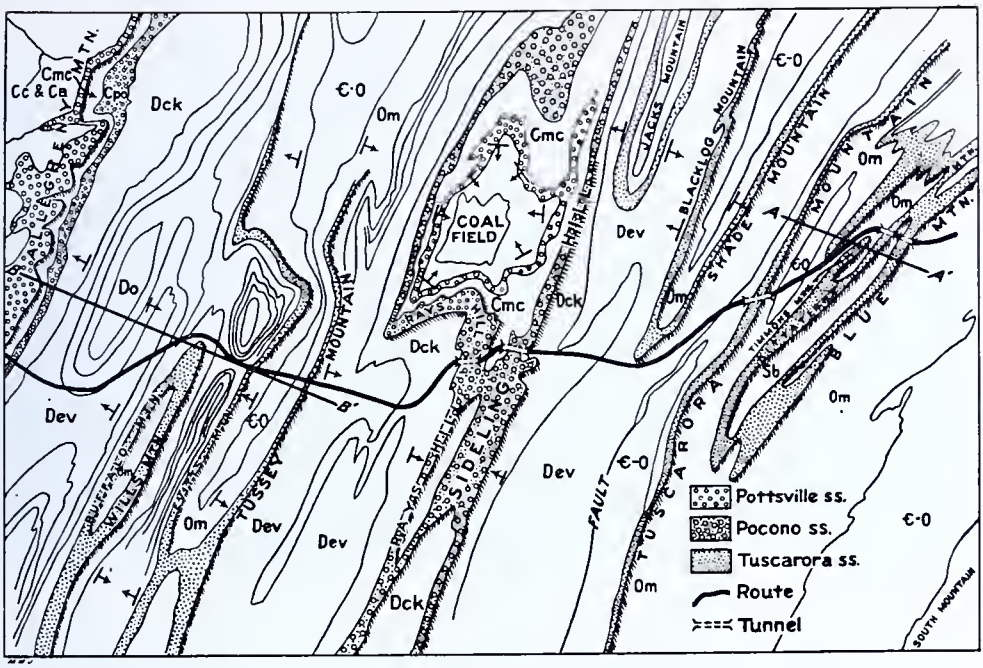


Figure 12. Geologic map of the Ridge and Valley section of the Turnpike route

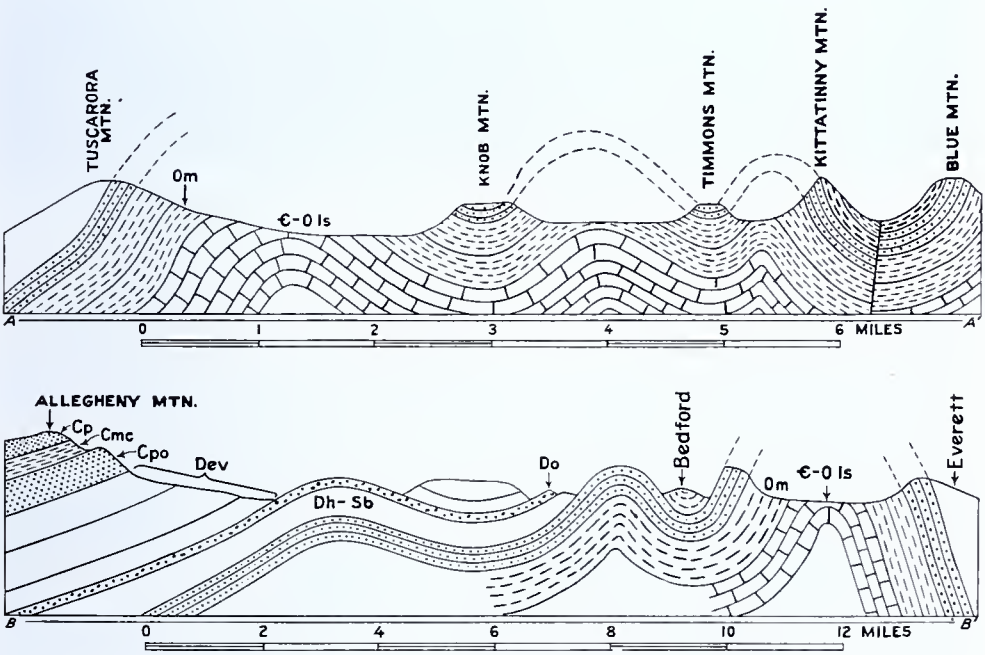


Figure 13. Cross sections of Turnpike geology as shown in Fig. 12

Block 3. Kittatinny-Tuscarora Tunnels. (11.1 miles)

From the west portal of Kittatinny Mountain tunnel to the east of portal of Tuscarora Mountain tunnel the Turnpike is in rocks below the hard Medina sandstone. Much of the way it runs between sharp down folds that bring that sandstone down to make Timmons Mountain on the southeast and Knob Mountain on the northwest (see figures 12 and 13). Fortunately those two folds die out in this area and the Turnpike dodges around the north end of Timmons Mountain and passes the south end of Knob Mountain. Most of the way it follows the West Branch of Conococheague Creek, running along the strike in the Martinsburg shale that underlies the Medina. Through Amberson Valley, the Medina, if restored, would make a relatively low roof. Crossing the more open valley from the end of Knob Mountain to Tuscarora Mountain the arch is higher, bringing up some of the underlying Cambro-Ordovician limestones. The valley here is between 800 and 900 feet above sea level. The mountains on all sides are just about 1,000 feet higher. Tuscarora Mountain is a long unbroken ridge (fig. 14), cut only by the Juniata River on the north and the Potomac on the south. It must, therefore, be climbed or tunnelled. The Turnpike tunnel is slightly more than 1,000 feet above sea level. Route 30 crosses the mountain at about 2,150 feet. Route 22 follows the Juniata River through a gap.

Figure 14. Mountain made by upturned Tuscarora sandstone

ITINERARY

From Middlesex Miles		*From Irwin* Miles
29.0	West portal of Kittatinny Mountain tunnel; note black, dense, banded Martinsburg shale and fault close to portal. (See plate 5-B.) All cuts between the tunnel and the crossing of Conococheague Creek are in Martinsburg shale. Timmons Mountain, a synclinal spur of Kittatinny Mountain noses out just south of the Turnpike. Amberson Valley on north. (See figure 15.)	130.6
29.1	Note cove on south, minor plunging anticline.	129.5
29.4	North end of Timmons Mountain, rising syncline, with crest of Tuscarora and flanks of Martinsburg formations.	129.2
31.6	Valley of West Branch of Conococheague Creek; Martinsburg shale, partly concealed by wash from mountain.	128.0
34.5	Nose of Knob Mountain on north. The crest of mountain is Tuscarora sandstone. The underlying Martinsburg shale forms the lower part of the nose of the syncline.	125.1

Figure 15. Amberson Valley and Knob Mountain

35.4	Cross Conocoeheague Creek. Martinsburg shale on east, Chambersburg limestone on west. Continue in limestone almost to east portal of Tuscarora tunnel.	124.2
36.7	"Borrow pit" 50 feet north in field, near dirt road underpass. Note large blocks, light gray, dense, massive limestone weathering almost white, with "rosebud" concretions (siliceous impurities) and nodular weathering.	122.9
37.4	Ordovician limestone outcrop. See figure 16, view of highway looking east.	122.2
38.0	Willow Hill Interchange.	121.6
38.7	Path Valley gas station (e-b). Cuts from Tuscarora tunnel to Conococheague Creek are in Trenton limestone.	120.9
39.0	Eastbound from the tunnel one sees Timmons Mountain on the far side of West Branch of Conococheague Valley. As the Turnpike runs northeast, Knob Mountain rises like a volcano straight ahead, and Timmons Mountain is on the east. (Figure 17.) The two mountains are minor synclines held up by Tuscarora sandstone.	120.6

Figure 16. Cambro-Ordovician limestone dipping southeast. Knob Mountain in center distance and Timmons Mountain on right

39.25	East portal of Tusearora Mountain tunnel. Martinsburg shale, vertical at entranee. The Tusearora sandstone, praetieally vertical in tunnel, rises into the air eastward and plunges below the surfaee to the west. The tunnel is 5,326 feet long. Going east, pass into Chambersburg limestone.	120.35

Figure 17. Turnpike passing between Knob Mountain on left and Timmons Mountain on right

Block 4. Tuscarora Tunnel—Fort Littleton Interchange. (7.2 miles)

The Turnpike is above the Tuscarora sandstone on this stretch, though to stay so it dodges around the plunging north end of a sharp anticline that carries the sandstone below drainage at Burnt Cabins. The nose of this anticline is marked by Sidneys Knob (2,088 feet) where Scrub Ridge on the west and Cove Mountain on the east come together at the end of the fold. Immediately west of the west portal of the tunnel the Turnpike crosses the vertical edges of the overlying Silurian and basal Devonian rocks and passes into the Middle and Upper Devonian shales and sandstone that underlie the valley of Little Aughwick Creek. West of Burnt Cabins rises Gobblers Knob (1,954 feet), the south end of another sharp anticline that brings up the Tuscarora sandstone to form Shade Mountain on the east and Blacklog Mountain on the west. This anticline extends north and east in great strength until finally lost in the Western Middle Anthracite field in northern Schuylkill County.

ITINERARY

From Middlesex Miles		*From Irwin* Miles
40.35	West portal, Tuscarora tunnel. Approaeh cut in Wills Creek interbedded red and greenish-yellow shale.	119.25
40.65	Overhead bridge rests on Tonoloway limestone.	118.95
41.4	Bluish-gray, thin-bedded, dolomitie limestone (Tonoloway).	118.2
41.6-42.4	Interbedded red and greenish-yellow shale.	117.2-118.0
42.4	Faulting brings up Rose Hill, highly fossiliferous. See cuts on overpass road east of Burnt Cabins. Weathered shale east of Keefer may represent McKenzie.	117.2

42.5	Sidneys Knob (2,088 feet) on south. (Plate 8-A.)	117.1
42.9	Keefer, cream-colored quartzite, fossiliferous. Rose Hill complexly folded and faulted. Keefer exposed in three places.	116.7
43.0	Wills Creek (Bloomsburg) interbedded red and greenish-yellow shale; ripple-marked surfaces. Burnt Cabins (hamlet) on north. Faulting between 116.6 (43.0) and 116 (43.6).	116.6
44.5	Upper Portage (Brallier), greenish and sandy shale; fossils.	115.1
45.0	Gobblers Knob (1,954 feet) on north, point of rising anticline in Tuscarora sandstone. (Plate 8-B.)	114.6
45.6	Brallier shale.	114.0
45.7	Sandstone in Brallier shale, mostly green, less red.	113.9
46.2	Harrell, black, thin-bedded and sandy shale, with fossils, *Buchiola, Manticoceras.* Continues to Fort Littleton Interchange. Note shearing in several of the cuts as though affected by faulting.	113.4
47.0	Fort Littleton Interchange. Connects with U. S. Route 522. Scrub Ridge (1,600-1,850 feet) on southeast. West flank of anticline of which Cove Mountain forms east flank. The ridges unite in Sidneys Knob. (Plate 8-A.)	112.6

Figure 18. Typical highway bridge over Turnpike

Block 5. Fort Littleton—Sideling Hill Tunnel. (9.95 miles)

This stretch is entirely in Devonian strata, except just at the tunnel. Except where faults bring up the Lower Devonian Oriskany, the Turnpike crosses in order from east to west (or vice versa) Portage, Chemung, and Catskill rocks. There is enough sandstone in these formations to produce a small featured but rugged topography. Note that the highway is crossing a major syncline or basin in which occurs the Broad Top coal field a few miles to the north. In crossing the syncline the Turnpike encounters for the first time rocks of Mississippian age, Sideling Hill and Rays Hill being formed by the massive Pocono sandstone.

From Middlesex Miles		*From Irwin* Miles
47.0	Fort Littleton Interchange. Scrub Ridge on southeast, Gobblers Knob (1,954 feet) on north. (Plate 8).	112.6
47.25	Thin-bedded, black shale. Basal Upper Devonian.	112.35
47.7	Tully limestone and calcareous conglomerate.	111.9
47.9	Fault? Bluish-gray shaly sandstone and sandy shale; orange and bluish gray clay on west. Crinoids and brachiopod fragments.	111.7
48.1-48.8	Cuts in Portage shale.	111.5-110.8
49.6	Olive-colored shales, probably Portage. A few hundred yards north across Hustontown road the Helderberg limestone is quarried, and Oriskany chert shows in that road.	110.0
49.85-50.2	Portage shale in cuts. *Spirifer mucronatus*, var. *posterus*, *Conetes*.	109.75-109.4
50.4	Olive-drab shale with some greenish-gray sandstone, breaks down to pencil shale. Portage? Few fossils, *Camerothoechia*.	109.2
51.2-51.5	Interbedded green and red shales and grayish-green sandstone, weathers buff. Chemung?	108.4-108.1
51.5	Approximate contact Chemung-Catskill; fossils.	108.1
51.5-56.05	Catskill red shale and sandstone. Contact with Pocono concealed. Cherty shale near top.	108.0-103.55
55.1	Cove Valley gas station (w-b). Note high-terrace gravels on red shales near viaduct.	104.5
56.05	East portal, Sideling Hill tunnel. This is the longest tunnel on the pike, 6,632 feet. The section, figure 11, shows the sandstone dipping west at a low angle into the Broad Top syncline. Two faults were encountered. The whole tunnel is in the Pocono. Catskill red beds east of tunnel.	103.55

Figure 19. View west from Sideling Hill

Block 6. Sideling Hill Tunnel—Rays Hill Tunnel. (3.9 miles)

Sideling Hill and Rays Hill are both formed by the Pocono sandstone as it dips under the Broad Top basin on the east and rises out

of it on the west. The south end of the basin is very shallow and the highway barely gets into the Mauch Chunk. A little further north the basin is deeper, the sandstone steeper, and the overlying Mauch Chunk red shale makes a broad valley between the surrounding wall of Pocono sandstone and the rim of the high Broad Top plateau seen to the north. The complex lines of the ridges in this area hint at complex structure. Bald Knob, a little south of the Turnpike, reaches 2,300 feet, and the south point of the plateau reaches almost 2,400 feet. At one point on the divide 1½ miles southwest of Sideling Hill tunnel, it is only 40 feet to creek level on the east side and nearly 600 feet on the west side.

ITINERARY

From Middlesex Miles		*From Irwin* Miles
57.3	West portal, Sideling Hill tunnel. Mauch Chunk red beds. View from over tunnel looking west (see figure 19).	102.3
58.0	Rim of Broad Top coal field seen to north in distance.	101.6
60.6	Center of Broad Top syncline. Mauch Chunk red shales, Pocono sandstone float. Rays Hill on west.	99.0
61.2	East portal, Rays Hill tunnel. In this tunnel the Pocono rises sharply to the west so that the overlying Mauch Chunk is encountered on the east end, and underlying Catskill at the west end of the tunnel. Length, 3,396 feet. As against 1,428 feet elevation at the tunnel, Route 30 crosses almost over the tunnel at 1,932 feet, and reaches 2,196 feet a little further east.	98.4

Block 7. Rays Hill Tunnel—Bedford Interchange. (19.25 miles)

Between Rays Hill and Bedford the Turnpike in a few miles passes across all of the Devonian and Silurian, and the Ordovician down to the Beekmantown limestone in the center of the anticline about halfway between Bedford and Everett. The Tuscarora sandstone rises to outcrop in Tussey Mountain on the east side of the anticline and in Evitts Mountain on the west side. The Turnpike takes advantage of water gaps made by the Raystown Branch of Juniata River. Even then the deepest cuts and fills are in this part of its route (figure 24). The Clear Ridge cut about a mile east of Everett is 2,475 feet long, 390 feet wide at the top, and 153 feet deep. See Plate 9. It required the removal of 1,136,000 cubic yards or 2,480,000 tons of rock, enough to fill 33,200 railroad cars of 75 tons capacity. Actually 15-ton-capacity Euclid trucks were used. For safety, a 23-foot bench, 30 feet above the floor of the cut and a 15-foot bench at 85 feet up, were cut in the slopes to handle drainage and rock falls. The original plans called for a tunnel here.

A 125-foot cut was made at Mt. Dallas where the Turnpike slices off the nose of Tussey Mountain. The cut is 800 feet long and required moving 250,000 cubic yards or 550,000 tons of rock, enough to fill 7,325 railway cars. Plate 10, A. This cut was made necessary by the presence of a railway and another State highway on the same side of the river. The State highway is cared for in a safety bench

50 feet above the Turnpike. Plate 10, B. In figure 21 is shown the deepest fill along the highway, 98 feet.

In general the rocks rise slowly from east to west between Rays Hill and Everett, first a broad belt of Catskill, then one of Chemung, then in order, Portage, Hamilton, and narrow belts of Oriskany and Helderberg, as the strata turn up sharply near Tussey Mountain. A fault traceable for many miles to the north cuts the east flank of Tussey Mountain. West of Evitts Mountain is a small syncline that brings the Helderberg limestone down to Turnpike level near Bedford.

Between Breezewood and Bedford Interchange the Turnpike follows Raystown Branch of Juniata River, which in this portion is as undecided in its course as a bird dog in a stubble field. Between two points it is ¾ mile across in a straight line and 12 miles around. Brush Creek, which the highway crosses near Breezewood, is likewise a stream of many meanders. These are believed to be due to delayed downcutting by some hard stratum further down stream. The water gaps were until recently ascribed to the downcutting of a river that had gotten its set in a south of east direction on an old plane of erosion, that, if restored today, would be high above the present ridges. The slight lack of alignment of both Evitts and Tussey Mountains at the river, suggests a zone of displacement and possibly of weakness just at the water gaps and points toward a different and more complicated history. No detailed regional study of the area has been made as yet. The old theory will have to stand for the present.

Figure 20. Rays Hill and west entrance of tunnel

ITINERARY

From Middlesex Miles		*From Irwin* Miles
61.85	West portal, Rays Hill Tunnel. All cuts between tunnel and Clear Ridge cut are in Catskill red and green shales and sandstones, locally folded and faulted.	97.75
63.25	Route 30 (Lincoln Highway).	96.35
63.8	Breezewood Interchange.	95.8

70.1-70.5	Clear Ridge cut, 153 feet deep and 2,475 fet long. Plate 9. Deepest cut in eastern United States. Chemung rocks, interbedded sandstone and shale, dipping 53° S.E. Color banding of the rocks is notable. At the east end of the cut the Chemung grades into the Catskill. At the west end is a fill 98 feet high. (Figure 21.)	89.5-89.1
71.2	Cut in Chemung interbedded greenish- and chocolate-colored shales and sandstones, containing fossil *Pterinea chemungensis.*	88.4
71.3-71.5	Portage (Brallier ?) olive-drab shales.	88.3-88.1
71.8	Cut in Hamilton group, dipping 48° east; fossiliferous. Montebello(?) sandstone in middle, Ludlowville(?) shale at east end.	87.8
72.1	Needmore shales of Onondaga group in east end of cut.	87.5
72.2	End of Warrior Ridge, Lower Devonian in cut, including light-colored, sandy Oriskany (Ridgeley sandstone and Shriver chert). Helderberg (red soil), including New Scotland, weathering cherty, and Coeymans, crystalline, very fossiliferous limestone. Limestone exposed at bridge at west end of cut.	87.4
72.4	Site of Everett-Saxton iron works on south. Everett borough north of river. Former iron town. Note old slag piles. Center for game and fish.	87.2
72.7	Under three frame houses on south, old Colonial iron mine in Rose Hill (Clinton) hematite.	86.9
73.0	Juniata red sandstone, contact with Tuscarora. Aliquippa Gap, Tussey Mountain. Mt. Dallas cut 125 feet high, 800 feet long in Tuscarora white quartz sandstone and quartzite (ganister) dipping steeply eastward. See plate 10. *Arthrophycus* on sandstone in stream.	86.6
73.4	Contact of Juniata red beds and Bald Eagle (Oswego) sandstone shattered and faulted. Fairview member of Martinsburg observed.	86.2
74.6	Large quarry in Cambro-Ordovician limestone. From this point to the river bridge all cuts are in this limestone.	85.0

Figure 21. Fill 98 feet high, west of Clear Ridge cut

Figure 22. The Midway, near Bedford. A pedestrian tunnel connects the two stations

77.3	Juniata River bridge. Contact between Ordovician (Trenton-Beekmantown) limestone and Martinsburg shale concealed under flat. The Cambro-Ordovician limestone does not reappear to west until brought to the surface in central Ohio on the Cincinnati arch.	82.3
77.65	Cross over Lincoln Highway, Route 30.	81.95
77.7	Bald Eagle gray sandstone, transitional into Juniata red sandstone.	81.9
78.0	Contact of Juniata red and green sandstone and shale and Tuscarora white sandstone. Nearly vertical dip. Rose Hill in borings under bridge. Evitts Mountain.	81.6
78.1	Viaduct over Dunning Creek.	81.5
78.8	Oriskany (Ridgeley) yellowish-brown sandstone; fossils, including *Spirifer arenosus*, *Platyceras*, common.	80.8
79.0	Black shale (Onondaga) much weathered.	80.6
79.3	Midway gas stations (e-b, w-b). (Figure 22.)	80.3
79.6-80.0	Oriskany (Ridgeley) sandstone, weathered to sand. Glass sand quarried from this formation on Route 22 was used for making the 200-inch mirror of the great telescope on Mount Palomar in California.	80.0-79.6
80.2	Cherty beds lying on Keyser limestone.	79.4
80.45	Tonoloway shaly limestone; Keyser massive limestone at top of big cut.	79.15
81.0	Tonoloway limestone at underpass. Wills Mountain rises to southwest, culminating in Kinton Knob (2,642 feet).	78.6
81.1	Cut in Wills Creek greenish-yellow and dove-gray calcareous shale; occasional thin cherty or blue limestone with quartz veins and vugs.	78.5
81.1	Bedford Interchange. Bedford, settled in 1752, county seat of Bedford County. Fort Bedford (built 1758) important in French and Indian War. Washington's headquarters during Whiskey Rebellion. The famous Bedford Springs are two miles south of town, used since 1796; summer resort.	78.5

Block 8. Bedford Interchange—Allegheny Tunnel. (22.8 miles)

From Bedford Interchange to Allegheny Mountain tunnel the Turnpike follows Raystown Branch of Juniata River almost to its head. Starting at the east at the toe of a pronounced anticline that brings up the Tuscarora to form Wills Mountain (altitude 2,700 feet further south), the route crosses a broad, flat syncline that brings down all of the Devonian. Then as Allegheny Mountain is approached, the strata turn and plunge still lower, bringing down the Mississippian and Pennsylvanian to form the Appalachian coal fields.

Just at the toe of Wills Mountain the river, instead of following the soft Rose Hill strata where the Turnpike runs, cuts across through a gorge in the Tuscarora, revealing a bit of history not yet unravelled, but probably related to the same conditions that produced the meandering of the river further east. The Helderberg limestone crops out along the base of Buffalo Mountain. At Manns Choice, just south of the bridge over Raystown Branch of Juniata River (85.6), is Wonderland Caverns, the only developed cave close to the Turnpike. For a few miles the route crosses diagonally the westward-dipping edges of the Middle and Upper Silurian, and Lower and Middle Devonian, then as the structure levels off runs in the Chemung. Near New Buena Vista the route crosses the south end of a broad gentle anticline that further north brings up all of the Devonian, but where crossed by the Turnpike only Portage rises to the surface, and again the route is in the Chemung almost to New Baltimore. When climbing the east face of the mountain, the Catskill and Pocono are crossed. Allegheny Mountain tunnel is in Pocono sandstone at the east end, Mauch Chunk shale most of the way through, and crosses the Pottsville and Allegheny groups at the west end, all dipping gently northwest.

Allegheny Mountain throughout this area is from 2,700 to 2,900 feet high with slight gaps below 2,700 feet. Near the tunnel the ridge is double, the Pottsville sandstone being responsible for the western or principal ridge and the Pocono sandstone for the eastern ridge. The Raystown Branch heads between the two ridges. Most of this block is across an area of mild relief because of the general softness of the strata. The general elevation of drainage is between 1,100 and 1,300 feet above sea level.

The New Baltimore meteorite, the fifth one of seven found in the State, was plowed up on the crest of Allegheny Mountain in 1922, four miles north of the tunnel.

ITINERARY

From Middlesex Miles		*From Irwin* Miles
81.1	Bedford Interchange in Wills Creek shales.	78.5
81.35	McKenzie limestone, interbedded with brown, weathered, fossiliferous shale. Red shale (Bloomsburg?) at west end of cut.	78.25
81.6	Colonial iron ore workings, pits and mounds (Clinton)	78.0
81.7	Rose Hill shale. Stream gravel in upper third of cut.	77.9
82.2	Axis of anticline plunging north. Westbound, crossing strata in rising succession. Note gorge where river was let down across nose of Wills Mountain and cut in Tuscarora sandstone.	77.4

82.6	Colonial iron pits on top of hill. Note refuse, and red and brown shale.	77.0
82.8	Rose Hill (Clinton) shale; note abundance of red shale.	76.8
83.0	Wills Creek greenish-brown shales.	76.6
83.2	Tonoloway shaly limestone. Wills Creek formation at east end of cut.	76.4
83.45	Tonoloway limestone on south, much weathered. Ostracods.	76.15
83.9	Cross over Lincoln Highway, Route 30.	75.7
84.4	Cut 60 feet deep; in Keyser limestone at east end, Coeymans (Helderberg) limestone at west end.	75.2
84.6	Oriskany (Ridgeley) sandstone, some fossils.	75.0
85.0	Overpass; Needmore (Onondaga) black shales, slickensided.	74.6
85.4	Tully-Moscow (Hamilton) contact; fossils.	74.2
85.45	Tully-Moscow limestone and shale on south; fossils.	74.15
85.6	Juniata River bridge. Excellent exposures and fossil collecting; Tully limestone 8 feet thick, with overlying Burket (Genesee) and underlying Moscow (Hamilton). Sharp contacts. Note profile of nose of Wills Mountain, revealing the rapid plunge of the anticline. At Kinton Knob the mountain divides into Wills Mountain on the east and Buffalo Mountain on the west. Note the many gaps in Buffalo Mountain through which the drainage from the center of the anticline escapes.	74.0
91.4	Portage olive-drab shale, in quarry and north and northwest of bridge; many fossils.	68.2
96.4	New Baltimore gas station (e-b). Chemung or Portage interbedded shale and sandstone, opposite gas station. Dip 10° northwest. Raindrop impressions; only fossils, fucoids or worm tubes. Buffalo Mountain (2,100 feet high) on the east with many water gaps.	63.2
97.6	Carmelite Mission and bridge at New Baltimore; interbedded platy shale and sandstone; some fossils.	62.0
97.6-102.5	Catskill red and green shales and red sandstone. One cut 102 feet deep has given trouble by sliding. Overhead bridge at 101.75 (57.85). Good view of Allegheny Front to north. Ripple marks on red sandstone, 98.7-60.9.	62.0-57.1
102.5-103.25	Pocono formation.	57.1-56.35
103.25	East portal, Allegheny Mountain tunnel (6,070 feet long), in Pocono rocks. Most of tunnel in Mauch Chunk shales, with gentle west dip. East face of Allegheny Mountain consists of Pottsville sandstone at the crest. Mauch Chunk red shale and sandstone below, resting on Pocono sandstone that makes the lower face of the mountain and a parallel ridge broken by water gaps that let out the drainage between the two ridges.	56.35

Block 9. Allegheny Tunnel—Somerset Interchange. (12.3 miles)

This section of the Turnpike averages above 2,300 feet in elevation, reaching almost 2,500 feet in crossing Negro Mountain and dropping down to about 2,100 feet at Somerset. The topography is mild (see plate 11, A), notwithstanding the high elevation, because supported by the nearly flat-lying, resistant Pottsville sandstone, which is seldom far below the surface and is exposed in some of the adjoining valleys. The rocks crossed are all Allegheny or "Lower Productive Coal Measures," or Conemaugh, "Lower Barren Coal Measures."

The structure is a mild anticline at Negro Mountain with a mild syncline (Somerset) on the west, and a stronger syncline (Berlin) between Negro Mountain and Allegheny Mountain. Further south the Negro Mountain anticline becomes higher and broader, the top forming a small plateau above 3,200 feet high, and Mt. Davis, the highest spot in the State, 3,213 feet above sea level.

ITINERARY

From Middlesex Miles		*From Irwin* Miles
104.4	West portal, Allegheny Mountain tunnel. End of tunnel in Allegheny rocks, dip 5°-7° north of west. Going west, higher and higher strata are crossed. Waste dumps near portal are rock from tunnel.	55.2
105.1	Brush Creek coal, 23 inches thick and adjoining strata dip 7° west. Note the 6 feet of clay under the coal, a characteristic of all the coal beds in this field (see Plate 12). Fossil pectens in shale over coal.	54.5
105.6	Lower Bakerstown coal, 18-inch blossom.	54.0
105.85	Upper Bakerstown coal, 28-inch blossom, dipping west.	53.75
106.1	Harlem coal, 25 inches. Dip 4° west. Middle of Conemaugh group.	53.5
106.4	"London Bridge" road, Shanksville to Roxbury. Barton coal, 15 inches, and limestone, 28 inches. Dip 4° west.	53.2
106.8	Limestone; bloom of Wellersburg coal in top of cut. Dip 4° west.	52.8
107.04	Crossing Stony Creek, elevation 2,220 feet.	52.56
107.1	Cross axis of Berlin syncline. From here west strata dip east. From here east strata dip west.	52.5
107.6	Bloom of Wellersburg(?) coal.	52.0
107.95	Cross Glade Creek.	51.65
108.4	Upper Bakerstown coal below grade.	51.2
108.85	Lower Bakerstown horizon.	50.75
109.1	Blossom of Brush Creek(?) horizon.	50.5
109.6	Mahoning sandstone, basal Conemaugh.	50.0
110.5	East end of Negro Mountain cut. This cut is 1,500 feet long, 67 feet deep, and has a ¾ to 1 slope. It replaces a partly driven tunnel. Upper Freeport (E) coal (44 inches) exposed in cut and mined in this region. Mahoning coal under sandstone at top of cut.	49.1
110.95-112.7	Upper Kittanning coal bed exposed in several cuts. Note the anticlinal roll near the maintenance building, and abandoned railroad grade at 111.6-48.0.	48.65-46.9
114.2	Somerset gas station (w-b).	45.4
114.65	Upper Hamilton shale and conglomerate, fossiliferous.	44.95
115.2	Old mine on Upper Kittanning coal below highway grade; interbedded shale, sandstone, fire clay, and 16-inch coal above grade.	44.4
116.15	Bridge over Baltimore & Ohio Railroad. Starting in middle Allegheny, pass over higher and higher strata on going east.	43.45
116.7	Somerset Interchange. See Plate 11, A. Connects with U. S. Route 219.	42.9

Block 10. Somerset Interchange—Laurel Hill Tunnel. (9.5 miles)

Somerset (2,190 feet above sea level) is the county seat of Somerset County, sometimes called "The Roof Garden of Pennsylvania," a borough of 5,865 inhabitants. Next to Berlin, a mining town a few miles to the southeast, this is the highest borough in the State. The Court House is said to be the highest public building in the State. Nearby are Quemahoning Reservoir, 13 miles around, and the Laurel Hill Recreation Demonstration project, with a 45-acre lake.

Between Somerset and Laurel Hill tunnel the Turnpike keeps above 2,000 feet, dipping about to that altitude in crossing Laurel Hill Creek valley and rising nearly to 2,300 feet at Quemahoning Cut 5½ miles west of Somerset, which replaced a tunnel previously driven.

ITINERARY

From Middlesex Miles		*From Irwin* Miles
116.7	Somerset Interchange. Plate 11, A. From here to Quemahoning Cut the rocks are all in the Conemaugh or "Lower Barren Coal Measures" and show thin coals (12 inches or less) and typical shales, sandstones, and a little limestone.	42.9
120.3	Quemahoning Cut, 85 feet deep, 1,250 feet long. The rocks exposed are shales, some red, clays, and sandstones typical of the Upper Conemaugh.	39.3
120.65	Turnpike passes over old limestone mine. The entrances were walled up, and dry, crushed slag was flushed into the mine and distributed by hand.	38.95
121.6	Limestone, 7 to 8 feet thick, dip 1° east. Stripping on north. Distant view of Laurel Hill to west.	38.0
122.2	Cut in buff sandstone and shale over Berlin coal.	37.4
122.25	Ames limestone horizon, here a fossiliferous, black shale and under it the Harlem coal, 16 inches thick. Dip 3°. east.	37.35
123.0	Top of Brush Creek black shales.	36.6
123.1	Brush Creek coal (12 inches) and overlying black fossiliferous shale. Big cut at 36.3 in bluish-gray shale.	36.5
123.5	Mary Bell mine, Upper Freeport coal, 42 inches thick with binders. Top of Allegheny group. This is one of several mines lying in the right of way of the Turnpike. To avoid future subsidence through settling of the ground over mined-out area, these mines were either excavated with power shovels and scrapers to below the coal and backfilled or slushed after walling up rooms and entries. Plates 13 and 14.	36.1
123.8	Laurel Hill gas station (e-b).	35.8
124.15	Brookville coal, 7 inches thick. Base of Allegheny, top of Pottsville. Dip 6° east. Strata are rising to the Laurel Hill anticline.	35.45
124.45	Bottom of Pottsville, top of Mauch Chunk red shale. Dip 3° east. Mauch Chunk red shales and sandstones seen in all cuts from here to east portal of Laurel Hill tunnel.	35.15
125.5	Loyalhanna limestone quarry on south above grade opened to furnish crushed stone for the Turnpike. Dip 1° east. Mauch Chunk red and green shale and greenish sandstone for nearly one mile east of tunnel.	34.1

126.2 East portal, Laurel Hill tunnel. The tunnel is cut in the basal part of the Mauch Chunk and in the Loyalhanna limestone (see figure 11). The tunnel has a total length between portals of 4,541 feet. Because of the caved condition of the old east heading a new east heading was driven. 33.4

Figure 23. View through a Turnpike tunnel

Block 11. Laurel Hill Tunnel—Donegal. (9 miles)

Donegal is near the top of the east flank of Chestnut Ridge. Laurel Hill tunnel is nearly 400 feet below the crest of Laurel Hill, which at this point rises to 2,800 feet above sea level. The tunnel is 4,541 feet long. Between the tunnel and Donegal the surface dips to 1,500 feet in the valley of Indian Creek. Much of the route, however, is above 1,800 feet. As you approach Laurel Hill from either side, notice its generally level crest which rises from 2,800 to 2,940 feet above sea level. Three hills within four miles south of the tunnel reach 2,940 feet. Laurel Hill forms a continuous ridge from Conemaugh River on the north to Youghiogheny River on the south, and is formed by a sharp arching of the rocks. Notice the dips either side of the ridge and the section in the tunnel (figure 11). The rocks in the tunnel dip gently because they are near the top of the arch. Between Donegal and the tunnel is a mild syncline or basin, the Ohiopyle syncline, that brings down to the surface adjoining the Turnpike the lower part of the Conemaugh group of rocks up to and including the Lower Bakerstown coal and the Woods Run limestone. The rocks between Donegal and the tunnel rise toward Laurel Hill so that in succession from west to east the Allegheny group of rocks and coals, the Pottsville sandstone, Mauch Chunk red beds, the Loyalhanna limestone, and the Pocono sandstone are crossed.

From Middlesex Miles		*From Irwin* Miles
127.0	Laurel Hill tunnel. See section in figure 11 for exposure in tunnel before it was sealed.	32.6
127.1-128.9	Passing over Pocono sandstone approaching top of Laurel Hill anticline.	32.5-30.7
128.9-129.1	Loyalhanna limestone. Dip 5° west.	30.7-30.5
129.1-129.3	Passing over Mauch Chunk red shale and sandstone on west flank of Laurel Hill anticline, dip up to 7° west.	30.5-30.3
129.3-129.75	Outcrop of Pottsville, mostly sandstone, some pebbly and cross bedded.	30.3-29.85
129.8-131.6	Outcrop of Allegheny group dipping to west; reach bottom of syncline.	29.8-28.0
131.6-133.6	Strata about horizontal; rise to east brings base of Conemaugh and E or Upper Freeport coal at top of Allegheny to the surface. Spurs of Laurel Hill appear as irregular mountains on the southeast.	28.0-26.0
133.65	Strata rising to east bring up Brush Creek horizon. Dip ½° west.	25.95
134.3	Lower Bakerstown coal and associated beds a little below middle of Conemaugh. Center of basin.	25.3
134.8	Woods Run limestone, a little higher in Conemaugh, dip 1° east, goes below grade 0.1 mile east. Broad view to north.	24.8
135.55	Brush Creek horizon, black shales, fossil pectens.	24.05
135.6	Bridge east of Turnpike ticket office. Brush Creek coal in lower Conemaugh.	24.0
135.9	Donegal Interchange. Connects with State routes 711 and 31.	23.7

Block 12. Donegal—New Stanton. (15 miles)

On this stretch the Turnpike crosses Chestnut Ridge and passes from the Pittsburgh section of the Appalachian Plateau province on the west to the Allegheny Mountains section on the east (or vice versa). The rocks at New Stanton rise over the Fayette anticline. Chestnut Ridge, which has an altitude of 2,200 feet or more, is crossed by the Turnpike below 1,700 feet by way of Jacobs Creek which rises on the east side of the ridge and flows west across it. At Donegal on the east flank the elevation is about 1,850 feet. Chestnut Ridge is formed by a sharp upfold that brings to the surface all the rocks down to and including the Pottsville sandstone. This massive sandstone and the underlying Pocono sandstone are responsible for the ridge. Further to the south Chestnut Ridge reaches elevations of 2,700 feet and deep ravines on its flanks cut through the Mississippian rocks and down to rocks of Devonian age.

The Mauch Chunk shale occurs between these sandstones. The contact between the Pottsville sandstone and the Mauch Chunk shale is unconformable, marking a long time break.

The center of the Latrobe basin is about 5 miles southeast of New Stanton Interchange. Here all of the Monongahela group is underground, the Pittsburgh coal being about 800 feet above sea level, and overlying it the Redstone, Sewickley, and Waynesburg coals. See plate 12.

From Middlesex Miles		*From Irwin* Miles
135.9	Donegal Interchange.	23.7
136.25	Donegal cut; Buffalo gray shale with limy nodules overlain by buff sandstone.	23.35
136.9-137.7	Brush Creek coal and black shale.	22.7-21.9
138.65-138.95	Upper Freeport coal crops out.	20.95-20.65
139.35	Pottsville, dipping east, rises to outcrop. The Allegheny with its coals underlies the road to the east. The highway crosses Chestnut Ridge by way of Jacobs Creek which rises on the east flank and flows across to the west.	20.25
139.85	Mauch Chunk, with east dip crops out, overlain by Pottsville sandstone.	19.75
140.05	Crest of Chestnut Ridge anticline.	19.55
140.25-141.25	Greenbrier limestone, abundant fossils, and Mauch Chunk red shale.	19.35-18.35
141.35	Mauch Chunk shale and sandstone.	18.25
141.6-142.6	Passing over Allegheny and Pottsville rocks, massive blocks.	18.0-17.0
142.6	Upper Freeport coal, 4 feet thick, at east end of cut, under massive gray Mahoning sandstone. Top of Allegheny formation.	17.0
142.85	Brush Creek coal and adjoining rocks.	16.85
143.0	Saltsburg sandstone, upper part of lower Conemaugh.	16.6
143.35	Mt. Joy cut with Wellersburg coal and Morgantown sandstone, lower part of upper Conemaugh; strata rising to east. Cut 97 feet deep, 1,200 feet long, nearly 300 feet wide at top, 500,000 cubic yards (1,100,000 tons, or 14,650 railway cars) of material excavated. Big fill at west end of cut.	16.25
143.65-143.75	Little Clarksburg coal and limestone, upper part of Conemaugh group.	15.95-15.85
144.1	Outcrop of Pittsburgh coal stripped on both sides of road.	15.5
144.25	Outcrop of Redstone coal, 66 inches thick.	15.35
144.45	Outcrop of Sewickley coal, 4 feet thick.	15.15
144.9-146.1	Benwood limestone outcrops, middle of Monongahela group, in center of Latrobe syncline.	14.7-13.5
146.7	Benwood limestone nodules in bank.	12.9
147.55	Redstone coal, 44 inches thick, and limestone.	12.05
147.7	Pittsburgh coal in old mine workings. Dip to east. Note waste pile.	11.9
147.9	New Stanton gas station (w-b).	11.7
148.25-149.65	Several cuts reveal typical Conemaugh rocks, including red shale and thin limestone (Pine Creek). Fossils in most of these cuts.	11.35-9.95
150.2-150.9	Crest of Fayette anticline. Upper Freeport coal, at top of Allegheny group, brought to the surface and mined. Note outcrop at road level just east of gas station on north side.	9.4-8.7
151.1	New Stanton Interchange. See Plate 11, B.	8.5

Block 13. New Stanton—Irwin. (8.4 miles)

The western end of the Turnpike is in the Pittsburgh section of the Appalachian Plateau province. The hilltops are 1,200 to 1,300 feet above sea level and very uniform in elevation. At the Irwin Interchange the Turnpike is 1,000 feet above sea level but rises to 1,150 feet south of Irwin and continues all the way in this block between 975 and 1,150 feet. The concordant elevation of the hilltops throughout this area suggests that they are the trace of an old erosion surface (Allegheny peneplane). Near Irwin in the center of the Irwin basin, the Pittsburgh coal is about 300 feet below drainage level. From there to New Stanton the rocks rise eastward. The Pittsburgh coal crops out 100 feet above Little Sewickley Creek at Arona. Note its outcrops and abandoned openings 6 miles from New Stanton or 2½ miles from Irwin. Coal and other rocks cropping out in the first two miles east of Irwin are all above the Pittsburgh coal in the Monongahela formation. The rocks in the cut at Arona are characteristic Conemaugh rocks. From New Stanton to Arona viaduct over Little Sewickley Creek and Hempfield Branch of the Pennsylvania Railroad the rocks dip northwest. The outcropping rocks belong to the Conemaugh group. Note, as indicated in the itinerary, the outcropping of the Clarksburg limestone underlain by red shales and sandstones.

ITINERARY

From Middlesex Miles		*From Irwin* Miles
151.2-151.95	New Stanton viaduct and Interchange. See plate 11, B. Connects with Route 119. Cross Sewickley Creek.	8.4-8.15
151.7	Brush Creek black shale and coal and Buffalo sandstone near base of Conemaugh group.	7.9
151.9	Hempfield gas station (e-b).	7.1
154.35	Axis of Greensburg syncline.	5.25
154.9	Axis of Grapeville anticline. Rocks change from west dip on west side to east dip on east side.	4.7
155.4-156.0	Red and green shales and thin limestones (Clarksburg) characteristic of Conemaugh group	4.2-3.6
156.15	Arona viaduct over Little Sewickley Creek and Hempfield Branch, P. R. R. Pittsburgh coal on north, culm pile on south.	3.45
156.6	Rocks of upper Conemaugh age. Little Clarksburg coal and limestone.	3.0
156.9	Lower Pittsburgh limestone, 1 foot thick, under one-half inch of coal (Little Pittsburgh).	2.7
157.25	Pittsburgh coal exposed in cut, west side. Abandoned openings on both sides. See plate 14. Note effect of acid mine waters on vegetation.	2.42
157.5	Pittsburgh coal outcropping on both sides of Turnpike; abandoned coal openings. Redstone limestone at west end of cut.	2.15
157.5-159.6	In Monongahela formation. In cut just east of Irwin Interchange these coal beds with under clays are exposed.	2.15-0
159.6	Irwin ticket booth. West end of Turnpike. Going east set odometer at zero. Mileage from Irwin to Carlisle is shown by white metal posts in the line of reflector markers on right or south side of the Turnpike. Odometers vary, so check distances by mile-posts.	0

Between Irwin and Pittsburgh. Route 30. (20 miles)

Based on notes by George H. Ashley and Penna. Geol. Survey Bulletin G 17, by Henry Leighton.

To facilitate reading either way, these few notes will also be divided into short sections:

Irwin—County Line. Irwin is a little west of the center of the Irwin basin, in which the Pittsburgh coal bed is 700 feet above sea level, or about 300 feet below drainage. From 900 feet at Irwin the Pittsburgh bed rises to over 1,250 feet on the Murrysville anticline, the axis of which crosses Route 30 just at the county line. Road cuts disclose the fresh-water limestones of the Monongahela group. The Pittsburgh coal crops out about a mile southeast of the crossing of the county line.

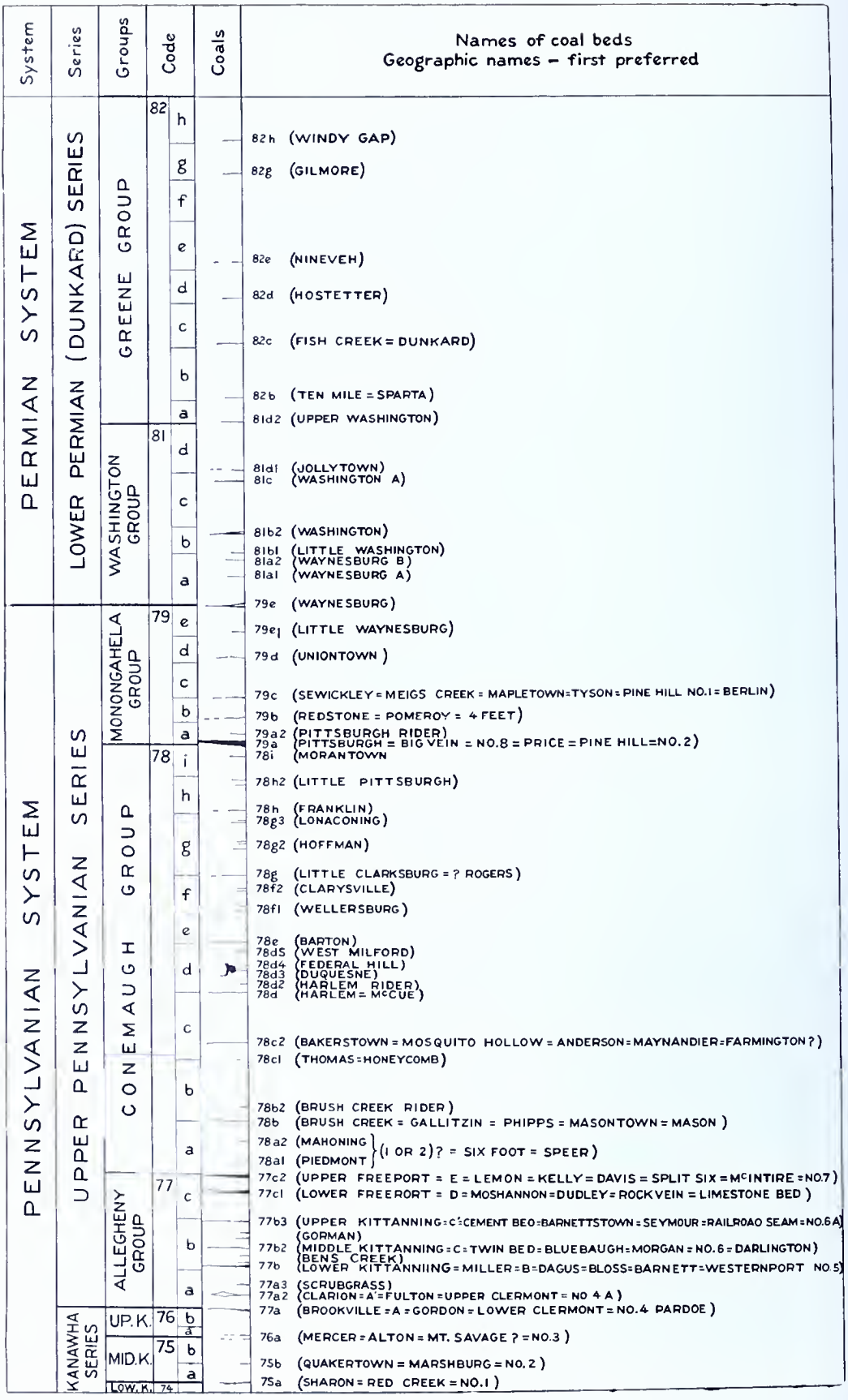
County Line—Westinghouse Bridge. From an altitude of 1,250 feet at the county line, the Pittsburgh coal descends only to 1,000 feet at the Westinghouse bridge, in the center of the Duquesne syncline. This brings the coal into the hilltops of this region and it is exposed at the highway level, one mile west of the county line, and in the first cut east of the bridge. The second cut east of the bridge exposes the Redstone coal, and the third cut shows a 30-foot cliff of the Benwood limestones in the Monongahela group. The Pittsburgh coal bed is below the highway throughout the East McKeesport area, as the highway keeps near the top of the ridge at 1,200 to 1,260 feet. At high points note the general level of the hilltops, trace of the Allegheny peneplane.

Westinghouse Bridge—Wilkinsburg. The Pittsburgh coal, which is 1,000 feet above sea level in the Duquesne syncline at the bridge, rises to 1,150 feet at Wilkinsburg. It still underlies the hilltops. Cuts along the highway expose cliffs of Morgantown sandstone in the upper Conemaugh underlain by the Wellersburg red clay. At 4.3 miles from the bridge the highway descends into the old pre-glacial channel of Monongahela River which, with a width of about a mile, makes a great horseshoe curve from the river at Swissvale past Edgewood, Wilkinsburg, East Liberty, and the "Civic Center" at Schenley Park and the University of Pittsburgh's 37 story "Tower of Learning." At present this oxbow is filled with silts (Carmichaels formation) formed when the waters of the old Monongahela and "Lower" Allegheny Rivers were ponded against glacial ice at the northwest. Later these waters found outlet to the southwest to form the present Ohio River and the drainage was lowered about 200 feet to the present water level.

Wilkinsburg—"The Point." The highway continues in the old oxbow by way of Penn Avenue to East Liberty from where different routes lead to the downtown section and "The Point" at the junction of the Allegheny and Monongahela Rivers. The Pittsburgh coal underlies the tops of the hills in and about Pittsburgh. In "downtown" Pittsburgh, the Ames limestone, in the middle of the Conemaugh group, is only a few feet above street level (Liberty or Smithfield Streets), about 740 feet above sea level, and 40 feet above the rivers.

A. Somerset interchange, looking east

B. New Stanton interchange



Sequence of coal beds

A. Upper Freeport coal mine east of Laurel Hill tunnel

Tar-coated pipes in lower left corner were placed under the Turnpike to carry mine water away.

B. Close up, showing thickness of coal and method of packing

A. Turnpike cut showing abandoned mine in Pittsburgh coal

B. Excavation to floor of Pittsburgh coal for foundation of overpass bridge